

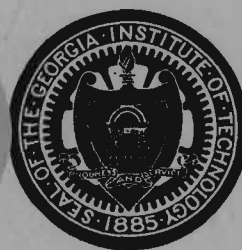
THE POTENTIAL IMPACT OF JUMBO-JET AIR CARGO TRANSPORTATION ON GEORGIA

by Richard H. Coe
and David S. Clifton

INDUSTRIAL DEVELOPMENT DIVISION

Project E-900-002

1970



Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
Atlanta, Georgia

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Foreword

Of necessity, existing national and regional transportation problems must be given increased attention during the next decades. One of the most pressing and complex problem areas is the need for better and more efficient systems of transporting goods.

This study relates to one system of moving goods which appears to have considerable potential. It was produced by Mr. Richard H. Coe, who has an extensive background in the aircraft industry, on special assignment with the Engineering Experiment Station. Although the report has been edited and expanded by Mr. David Clifton of the Industrial Development Division's Market Analysis Section, full credit for the assumptions, conclusions, and supporting data must be given to Mr. Coe.

This report is one of a series of transportation-related studies being undertaken or contemplated by the Division. The availability of transportation and distribution systems has always been a major element of industrial development activities. These studies will seek to identify specific activities which have promise of solving some of the problems of multi-modal transportation systems.

Comments and suggestions pertaining to this publication are invited.

Ross W. Hammond, Chief
Industrial Development Division
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Summary

The advent of the jumbo jet as a means of shipping commodities has implications for Georgia's future. It could significantly affect the development of air cargo transportation in Georgia, with resulting impact upon the industrial development of the state. The most attractive feature of air transportation, of course, is its ability to bring the producer and consumer closer together on a time basis. A major consideration, however, is the cost of air transportation relative to the cost of surface transportation.

The cost of air cargo transportation by jumbo jets is more competitive in the "low" density commodity range (5 to 9 lb./cu. ft.) and over long-haul freight routes. The type of carrier also affects the relative cost of air cargo transportation. For common carrier-operated jumbo jets, the potential cost of transportation for "competitive" commodities is as much as 12% lower than by typical common-carrier surface transportation.

Forms of jumbo-jet cargo operations other than common carrier (such as contract carrier, shipper-owned and operated aircraft, and a passenger-cargo mix) can reduce transportation costs even further below typical surface transportation common carrier costs. More efficient use of the aircraft, resulting in higher average load factors, reduced overhead, and shared revenue with passengers are factors which make possible the lower transportation costs in these forms of operation. The potential cost levels relative to typical common-carrier surface cost levels are estimated to be as follows:

- Contract carrier -- 40% reduction
- Shipper-owned and operated aircraft
(capital costs excluded) -- 60% reduction
- Common carrier passenger/cargo mix -- 30% reduction
(with passenger fares 10% below current levels)

It is recognized that transportation costs are lower for contract carrier and shipper-owned trucking operations than for common carrier operations. For simplicity, however, the common carrier cost levels have been used for comparison purposes.

The cost of air cargo transportation for "high" density commodities (average 20 lb./cu. ft.) over long-haul freight routes depends upon the form of

jumbo-jet cargo operations. The potential cost levels for jumbo-jet cargo operations related to typical common surface carriers are as follows:

Common carrier -- 40% greater

Contract carrier -- 20% greater

Shipper-owned and operated aircraft
(capital costs excluded) -- 30% reduction

Common carrier, passenger/cargo mix -- 35% greater
(with passenger fares 10% below current levels)

Development of air cargo transportation in Georgia will depend on the facilities available to service the jumbo-jet aircraft. A number of Georgia airports meet the runway requirements for the jumbo-jets, but, at the present time, only Atlanta's airport has the required automated air freight terminals and specialized ground handling equipment needed to facilitate rapid transfer of cargo.

Georgia-manufactured products in the "low" density range (5 to 9 lb./cu. ft.) which, for the first time, could be shipped at costs equal to, or lower than, common surface modes are as follows:

Men's clothing	Towels
Boys' clothing	Carpeting
Women's clothing	Certain snack foods
Lingerie	Household furniture
Blankets	

Commodities in the same density range moving into Georgia would include the following:

A wide spectrum of general department store merchandise
Most major home appliances

Commodities in the "high" density realm will generally move at lower transportation costs via the surface modes. Georgia-manufactured products in this category would include the following:

Cotton fabrics	Paper products and printed matter
Yarn	Chemicals
Certain food products	Glass, stone, and clay products
Lumber	

Equal-density commodities moving into Georgia could include any of the above items plus industrial machinery and steel products.

The potential impact of the jumbo jets on Georgia's industrial development can be assessed in terms of both the state's present manufacturing industry and the regional sales, service, and distribution facilities in the Atlanta Metropolitan Area. Georgia manufacturers of "low" density products that can be transported at lower cost in jumbo jets will find it easier and more economical to expand their markets and will be able to respond more rapidly to changing markets. Air transportation also opens up the possibility of shipping raw materials or subassemblies to Georgia for subcontract work. And Georgia manufacturing of air cargo transports should expand. On the negative side, distant manufacturers may ship more products to Georgia which would be competitive with local industry.

In terms of sales, service, and distribution functions, jumbo-jet cargo transport can enhance Atlanta's position as a transportation and distribution center, particularly in the realm of international commerce. Air carriers serving Georgia will have an opportunity for business development. Possible drawbacks include possible reductions in local transportation and warehouse requirements, due to air cargo transportation of products from other sections of the country.

It is considered that the probability is remote for the routine use of air transportation for "high" density Georgia products. Even jumbo-jet transportation for these products costs more (in common carriage) than surface transportation. Although compensating savings in air transportation (packaging, inventory reduction, warehousing) can be found, the development of air cargo as a mode of transportation is of necessity slower under these circumstances than when a clear-cut savings in transportation cost is available.

INTRODUCTION

The total cost of cargo transportation can be divided into the nontransport costs, which include warehousing, insurance, inventory, carrying costs, packaging, and other similar costs, and the transport costs. The most powerful influence in the development of air cargo as a major transportation mode is not the possible nontransport cost savings, but the cost of air cargo transportation relative to surface transportation.

The purpose of this study is to analyze the cost of cargo transportation in jumbo-jet aircraft relative to surface transportation. This cost comparison was used as a basis for an assessment of the future use of air cargo transportation in Georgia and its impact on the industrial development of the state.

FACTORS WHICH INFLUENCE THE RELATIVE COST OF AIR TRANSPORTATION

The cost of air cargo transportation relative to surface modes of transportation is affected by the following factors: the shipping density of the commodity, the shipping distance, and the type of air carrier.

The relative cost position of air transportation depends largely upon the shipping density of the commodity being transported. Figure 1 shows the relative transportation costs throughout a wide density range. As can be seen from Figure 1, the cost of common carrier air cargo transportation is more competitive in relation to truck and rail in the "low" density commodity range (5 to 9 lb./cu. ft.) than for "high" density commodities (average 20 lb./cu. ft.).

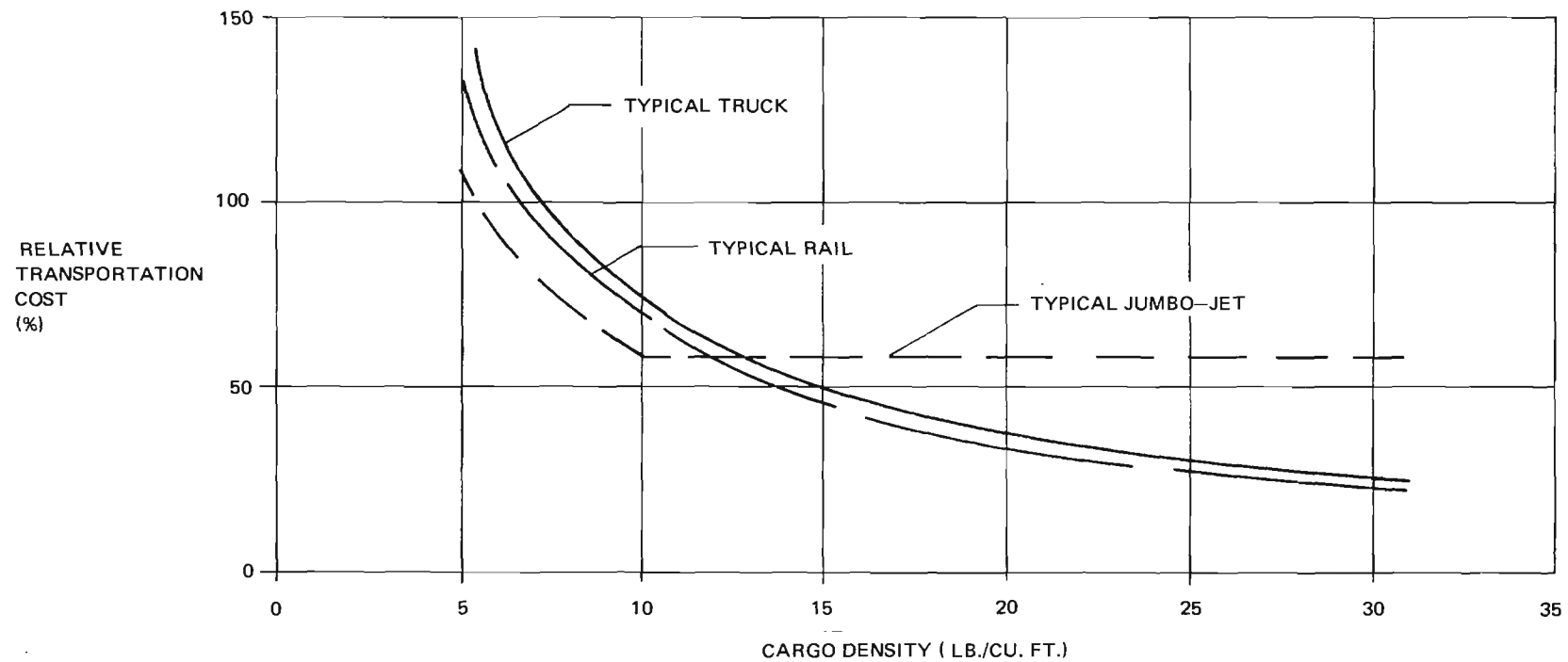
The classical approach to the marketing of air cargo transportation before the advent of the jumbo-jet aircraft was to acknowledge the premium costs in the "high" density realm, as shown in Figure 1, and trade-off warehousing, insurance, and other savings derived from speed of transit. The effectiveness of this marketing technique has certainly been less than dramatic. Current air cargo is still largely in the "low" density realm (as much as 70% of domestic air cargo is 10 lb./cu. ft. or less), where the basic cost of transportation is more competitive with surface modes. The availability of the jumbo jets and their associated lower transportation costs should make possible a major expansion in air cargo movement for commodities in the "low" density realm.

Another factor which will influence the expansion of jumbo jets into the cargo transportation market is the distance the commodity is to be shipped. The economics of the jumbo-jet aircraft dictate their most efficient usage on the long-distance routes. For the purposes of this study and the relative cost comparisons, a long distance is considered to be 2,000 miles.

In addition to these two factors, there are several operating variables which have a significant effect on the cost of air cargo transportation. The revenue load factor, which is defined as the percent of total capacity that is revenue producing (a cargo aircraft with a 100-ton capacity and carrying only 50 revenue tons has a 50% revenue load factor), and overhead costs vary according to the type of air carrier. The effect of these two factors on air transportation cost are examined in the next section.

Figure 1

EFFECT OF CARGO DENSITY ON RELATIVE TRANSPORTATION COSTS FOR COMMON CARRIER OPERATIONS



NOTE: TYPICAL TRUCK COSTS WITH CARGO DENSITY OF 7 LB./CU. FT. = 100%

COST OF CARGO TRANSPORTATION IN JUMBO-JET AIRCRAFT
RELATIVE TO SURFACE TRANSPORTATION

The methodology used for the basis of comparison of transportation costs was as follows. "Transportation costs" used for this comparison included dock to dock line haul costs plus handling costs for the carrier plus a typical current profit margin. It was recognized that the pricing of transportation is the result of multiple factors. The relative cost levels, however, are considered to represent potential relative price levels and the corresponding cost to the shipper.

Relative costs for different modes of cargo transportation were based on the two following conditions:

1. For cargo densities greater than design density, transportation costs were compared on a cents/ton-mile basis.
2. For cargo densities less than design density, transportation costs were compared on a cents/mile/cu. ft. basis.

Under the first condition, the carrier must charge for weight capacity sold; under the second condition, he must charge for space capacity sold. The design density was defined as the cargo density at which a fully loaded cargo space will have a cargo load weight just equal to the maximum weight limit. Jumbo-jet design densities are approximately 10 pounds per cubic foot. Design densities of truck and rail vehicles are frequently more than 30 pounds per cubic foot.

Costs were based, wherever possible, on published operating experience. In cases where detailed cost information was not available, published revenue yield levels were considered to be equivalent to the transportation cost definition. Information sources are recorded in the list of references.

Direct operating costs for the jumbo jets were based on a standard method in the air carrier industry for estimating such costs. The method, which accounts for the effect of aircraft size, was derived from many years of operating experience, and for current size aircraft represents a typical actual operating cost level. The indirect operating costs for the jumbo jets were based on information reported to the Civil Aeronautics Board by carriers operating current all-cargo aircraft.

The relative cost of air cargo transportation, as previously mentioned, is significantly affected by the revenue load factor and overhead costs. These factors depend upon the type of carrier operation. Therefore, the cost comparison between air and surface transportation will differ for each of the following four types of carriers:

- Common carrier, all-cargo operations
- Contract carrier, all-cargo operations
- Shipper-owned aircraft operations
- Common carrier, passenger cargo mix

Common Carrier, All-Cargo Operations

This is the most common type of air cargo transportation available today. The competitive cost positions of Figures 2 and 3 are based on this type of operation. The combination of competitive climate, service to multiple shippers, and typical scheduling requirements results in a revenue load factor of approximately 50% for a typical common carrier.

Contract Carrier, All-Cargo Operations

A contract carrier, with the presumed ability to depart only when a full load is on board, can significantly improve the average revenue load factor. It has been assumed that, with known traffic demand and careful scheduling, an average revenue load factor of 75% could be achieved.

Furthermore, the specialized operation should result in a reduction of certain overhead costs. These would include advertising and publicity, reservations and sales, and the cost of providing extensive ground facilities. Compared to jumbo-jet common carrier operations, the following cost changes are considered representative of contract carrier transportation:

Direct costs increased approximately 9% to allow for contract purchased maintenance service typical for this type of operation.

Indirect costs decreased by approximately 27% to allow for the aforementioned reduction in overhead.

Average revenue load factor increased from 50% to 75%.

The above changes result in a unit transportation cost (cents/revenue ton-mile) for the jumbo jets that is approximately 40% lower than equal-density transportation costs in typical surface transportation. This is illustrated in Figure 4, which shows the estimated competitive transportation cost position

Figure 2
COMMON CARRIER OPERATIONS: APPROXIMATE RELATIVE
TRANSPORTATION COSTS FOR "LOW" DENSITY COMMODITIES
(5 to 9 lb./cu. ft.)

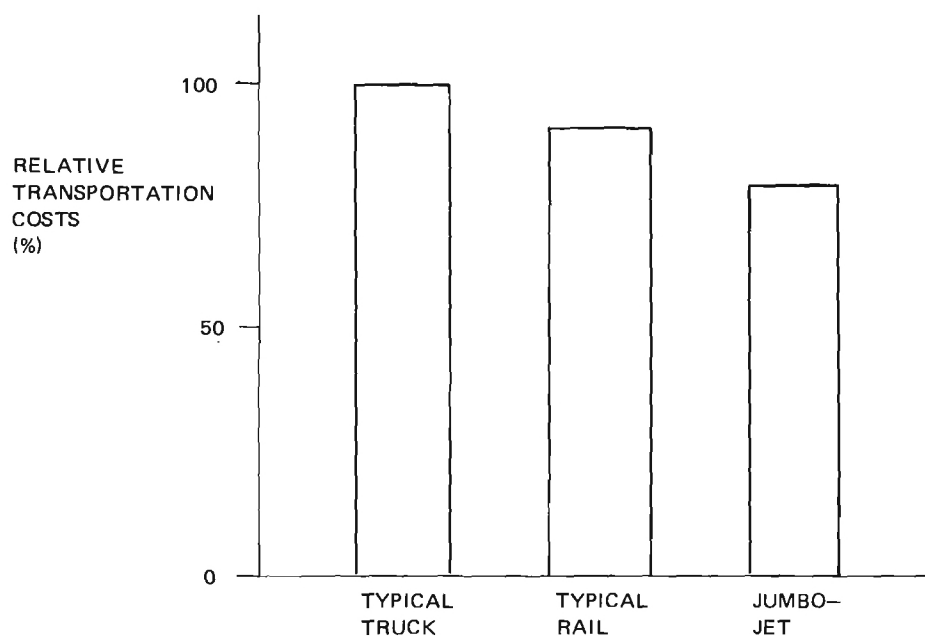


Figure 3
COMMON CARRIER OPERATIONS: APPROXIMATE RELATIVE
TRANSPORTATION COSTS FOR "HIGH" DENSITY COMMODITIES
(20 lb./cu. ft.)

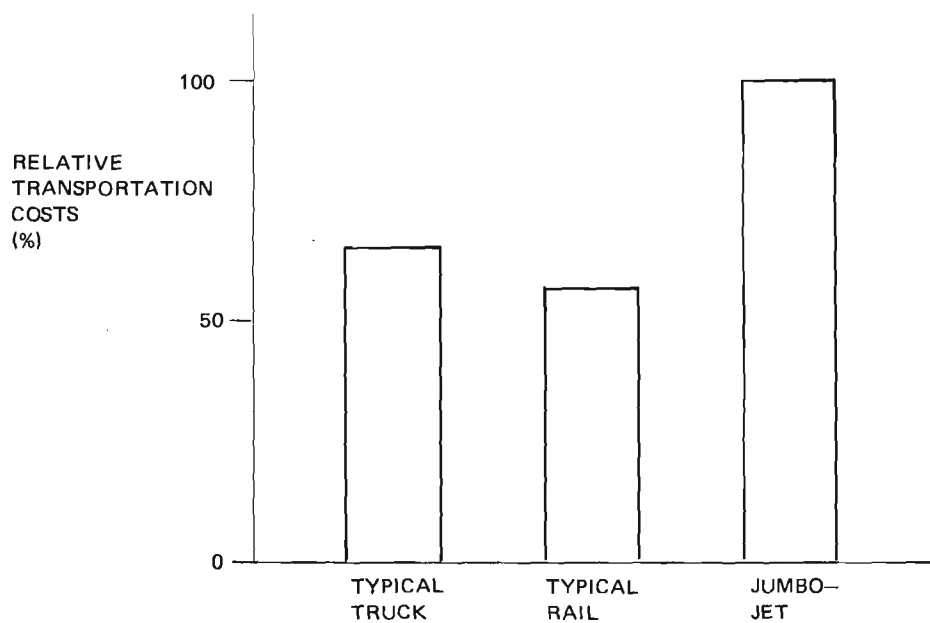


Figure 4
CONTRACT AIR CARRIER OPERATIONS: APPROXIMATE RELATIVE
TRANSPORTATION COSTS FOR "LOW" DENSITY COMMODITIES
(5 to 9 lb./cu. ft.)

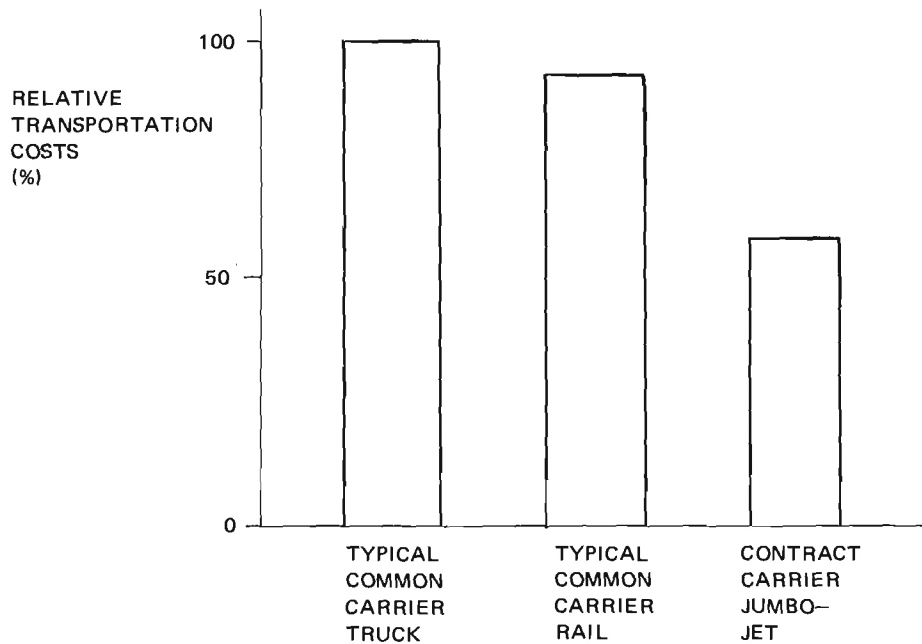
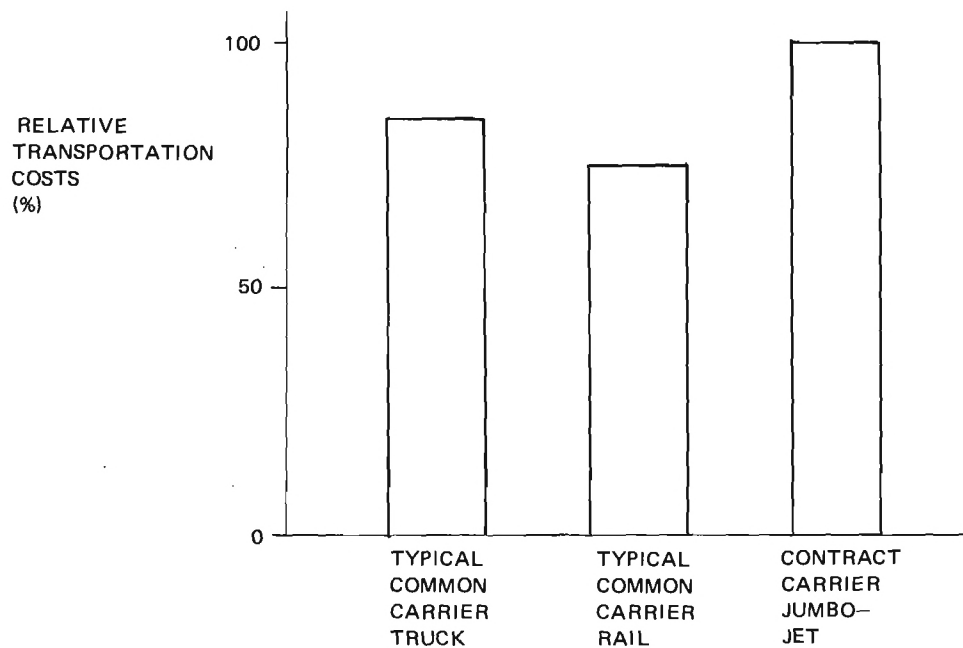


Figure 5
CONTRACT AIR CARRIER OPERATIONS: APPROXIMATE RELATIVE
TRANSPORTATION COSTS FOR "HIGH" DENSITY COMMODITIES
(20 lb./cu. ft.)



for a contract carrier transporting "low" density commodities (5 to 9 lb./cu. ft.). The air cost advantage disappears, however, when "high" density commodities (20 lb./cu. ft.) are transported. Since this density realm is beyond the design density of the aircraft, unit transportation cost for the jumbo jets is approximately 20% greater than for surface transportation. Figure 5 shows the contract carrier competitive cost position for these "high" density commodities.

Shipper-Owned Aircraft Operations

Cargo aircraft owned, or leased, by the shipper and used primarily for the transport of his products should have cost advantages over the common carrier due to low overhead and a high revenue load factor. Compared to jumbo-jet common carrier operations, the following cost changes would apply in general:

- Direct costs increased approximately 9% to allow for contract purchased maintenance service typical for this type of operation.

- Indirect costs decreased by approximately 57% to account for the elimination of advertising, publicity, reservations and sales, and a reduction in ground facilities as well as general and administrative costs.

- Elimination of capitalization and profit charges.

- Average revenue load factor increased from 50% to 60%.

The above changes result in a unit transportation cost (cents/revenue ton-mile) for the jumbo jets that is approximately 60% lower than equal-density transportation costs for "low" density products when surface modes are used. It should be noted that this low transportation cost does not include capitalization and profit charges. Figure 6 shows the estimated competitive transportation cost position for shipper-owned and operated jumbo jets in the transportation of "low" density commodities (5 to 9 lb./cu. ft.). Figure 7 shows the competitive cost position for transporting "high" density commodities (20 lb./cu. ft.). Despite the fact that this is beyond the design density of the aircraft, unit transportation cost for the jumbo jets is approximately 30% lower than for surface transportation.

Rail and truck costs represent typical common carrier cost levels, although it is recognized that shipper-owned trucking is not rare. Available information on trucking costs indicates a possible 45% further reduction for shipper-owned operations.

Figure 6
SHIPPER-OWNED AIRCRAFT OPERATIONS: APPROXIMATE RELATIVE
TRANSPORTATION COSTS FOR "LOW" DENSITY COMMODITIES
(5 to 9 lb./cu. ft.)

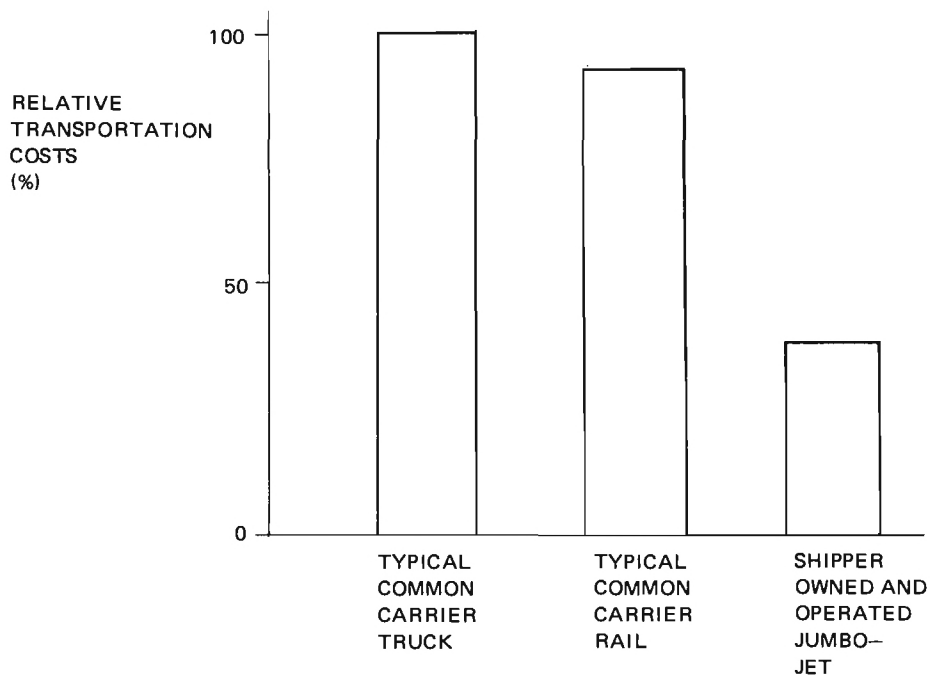
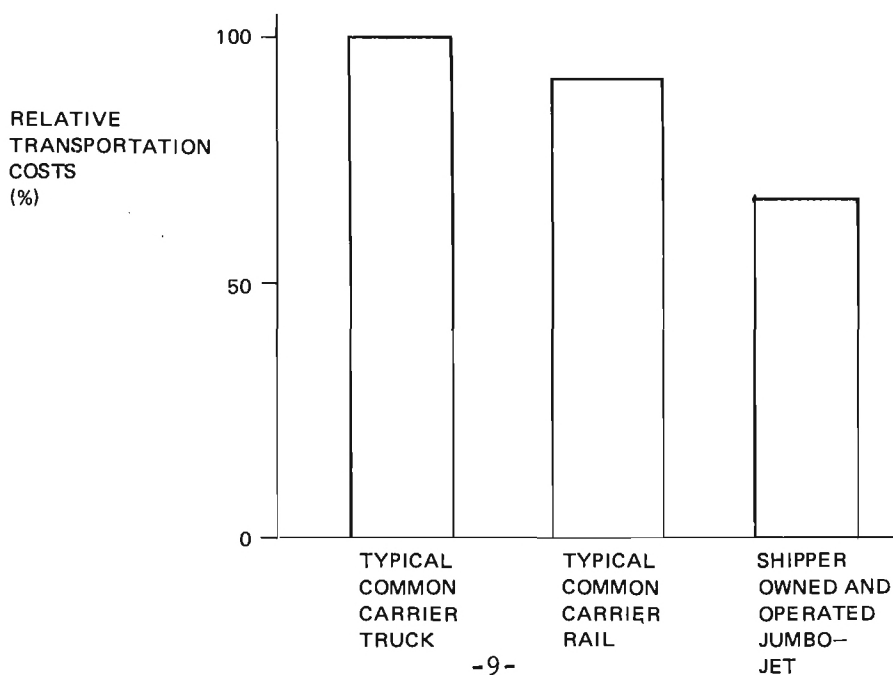


Figure 7
SHIPPER-OWNED AIRCRAFT OPERATIONS: APPROXIMATE RELATIVE
TRANSPORTATION COSTS FOR "HIGH" DENSITY COMMODITIES
(20 lb./cu. ft.)



Common Carrier, Passenger/Cargo Mix

Of the four types of air cargo operations considered herein, the passenger/cargo mix appears to have the greatest flexibility and development potential. For example, a Boeing 747 flight in which trip costs are more than covered by passenger revenues will have a large capacity for air cargo in the belly compartments. Such belly cargo should produce revenue well in excess of its added cost. The added cost of such belly cargo would consist, primarily, of the handling expense of putting it on board and accounting for it.

Even when total costs for passengers and cargo are fully allocated, possible revenue level trade-offs are very attractive. Under these conditions, total costs for passenger, or cargo, operations (sales, advertising, publicity, reservations, traffic servicing, general and administrative, etc.) would be charged to the flight in proportion to the number of revenue passenger-miles for passenger costs and in proportion to the number of revenue ton-miles for cargo costs.

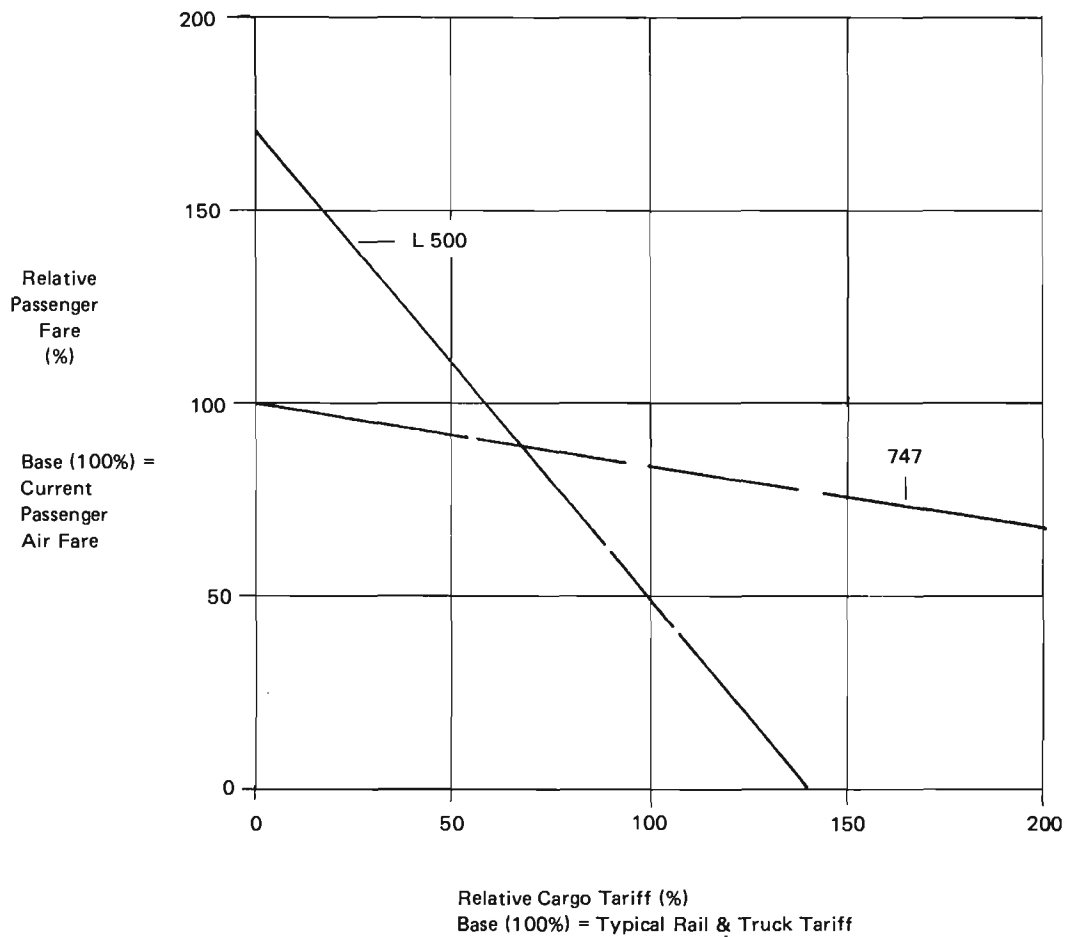
Figure 8 shows the possible passenger/cargo fare combinations that will cover the carrier's total costs plus a current typical profit margin. The costs are for cargo in the "low" density realm (5 to 9 lb./cu. ft.). Revenue load factors of 50% have been assumed for both passengers and cargo. The Lockheed 500 has the capacity to carry passengers on the upper deck while transporting large quantities of revenue-producing cargo in the main compartment. The passenger configuration of the 747 has a cargo capacity in the belly compartments far greater than the belly compartments of any passenger airplanes to date. The relative proportions of passenger and cargo capacity, as shown in Appendix A, account for the difference in fare trade-offs shown in Figure 8.

It is apparent from Figure 8 that cargo carried in the main compartment of the L 500 at tariff levels equal to those for rail and truck would permit passengers to be carried on the upper deck at fare levels as much as 50% below present passenger fare levels. Or passengers carried on the upper deck at current passenger fare levels would permit cargo to be carried at tariff levels as much as 40% below present surface tariff levels.

The 747, with cargo in the belly compartments at tariff levels equal to those for rail and truck, would be able to carry passengers at fare levels as much as 15% below present passenger fare levels. Or passengers carried at

Figure 8
PASSENGER/CARGO MIX:
TRADE-OFF OF REDUCTIONS OR INCREASES
IN CURRENT FARES REQUIRED TO
COVER ALL COSTS PLUS A PROFIT

(Commodity densities of 5 to 9 lb./cu. ft.)



current passenger fare levels would permit cargo to be carried at any desired tariff level, including zero.

Any one of many possible combinations of passenger and cargo fares could be very powerful in developing both passenger and cargo air transportation. It should be recognized, however, that traffic at fare levels below the jumbo-jet minimum for all-passenger operation or minimum for all-cargo operation should be restricted to the combination aircraft, i.e., passenger/cargo mix. Otherwise, a traffic demand may be created that cannot be profitably served in the all-passenger, or all-cargo, configuration, even with jumbo-jet aircraft.

For cargo in the "high" density realm (20 lb./cu. ft.), it is difficult for the jumbo jets to be cost competitive with rail and truck. The 747, however, could profitably carry such cargo in the belly compartments at fare levels equal to, or less than, rail and truck levels if passengers were transported at current passenger fares. Cargo would have to be restricted to the combination passenger/cargo aircraft since an all-cargo configuration could not provide the service profitably.

In summary, operators of the jumbo-jet aircraft in the passenger/cargo configuration should have the capability of providing air cargo transportation at costs very competitive with truck and rail throughout a wide spectrum of cargo density.

JUMBO-JET AIR CARGO TRANSPORTATION IN GEORGIA

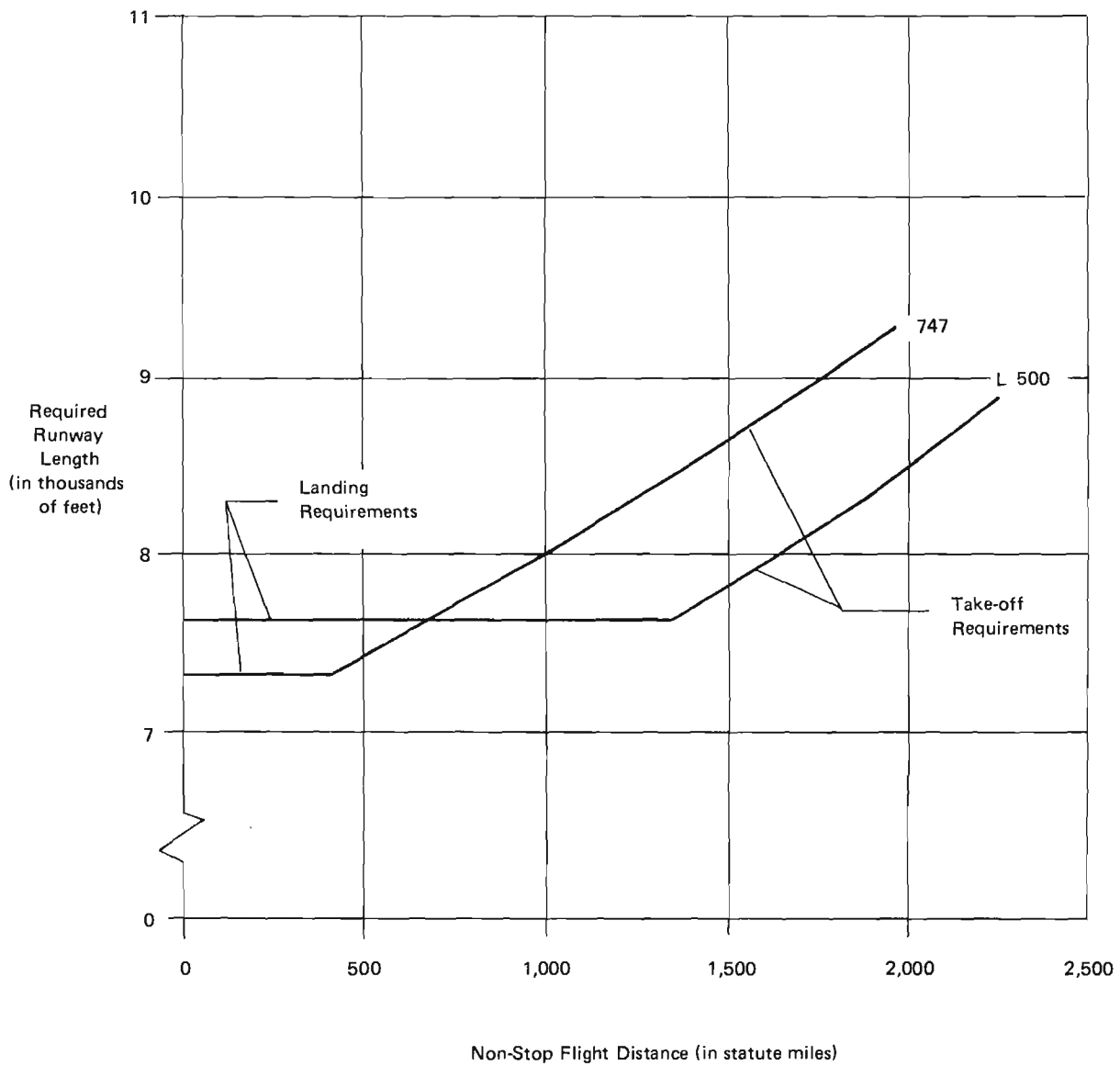
The ability of the jumbo jets to provide air cargo service to a particular Georgia metropolitan area depends, in part, on the length of the airport runways available. "International" runway lengths (over 10,000 feet) will be required only for non-stop flights of 2,900 statute miles or more. Most domestic U. S. service could be accommodated with runway lengths well under 10,000 feet.

Figure 9 shows the runway length required for full cargo loads and varying non-stop flight distances. If the length of a flight cannot be accommodated on a non-stop basis with the available departure runway length, en-route refueling stops will make the available runway adequate. As Figure 9 has shown, the runway length requirements depend upon the non-stop flight distance requirements. If the premise is made that a 1,000-statute mile trip from anywhere in Georgia will serve most of the major markets in the East or Middle West of the United States, then Figure 10 indicates that an 8,000-foot runway length would serve both take-off and landing requirements. Three of the major cities in Georgia currently have airports with a runway length of 8,000 feet or greater (Atlanta, Savannah, and Valdosta). Other candidate cities, such as Albany, Athens, Augusta, Bainbridge, Columbus, Gainesville, and Macon, would require extensions from 50% to 100% over the existing runway lengths. An alternative, of course, is to provide air or ground feeder service to the three major departure points.

The jumbo jets, with gross weights between 300 and 400 tons, require runway considerations other than length requirements. The landing gear of these aircraft have been designed to keep runway strength requirements as close to existing airport capabilities as possible. Without exhaustive treatment of a complex subject, the extent of the problem solution can be measured by the fact that neither the 747 nor the L 500 are expected to require any greater runway strengths than that required for the heaviest jets flying today (the McDonnell-Douglas DC-8-Series 60). For asphalt-covered runways on a "hard" soil base (California Bearing Ratio=20), the total runway thickness requirements are expected to be less than 20 inches.

Although there are a number of Georgia airports which could meet the runway requirements for jumbo-jet aircraft, other considerations make it improbable that any but Atlanta will function as a jumbo-jet airport in the foreseeable

Figure 9
COMMON CARRIER RUNWAY LENGTH REQUIREMENTS
 (Based on FAA Safety Regulations)
 Sea Level Altitude
 Full Cargo Load

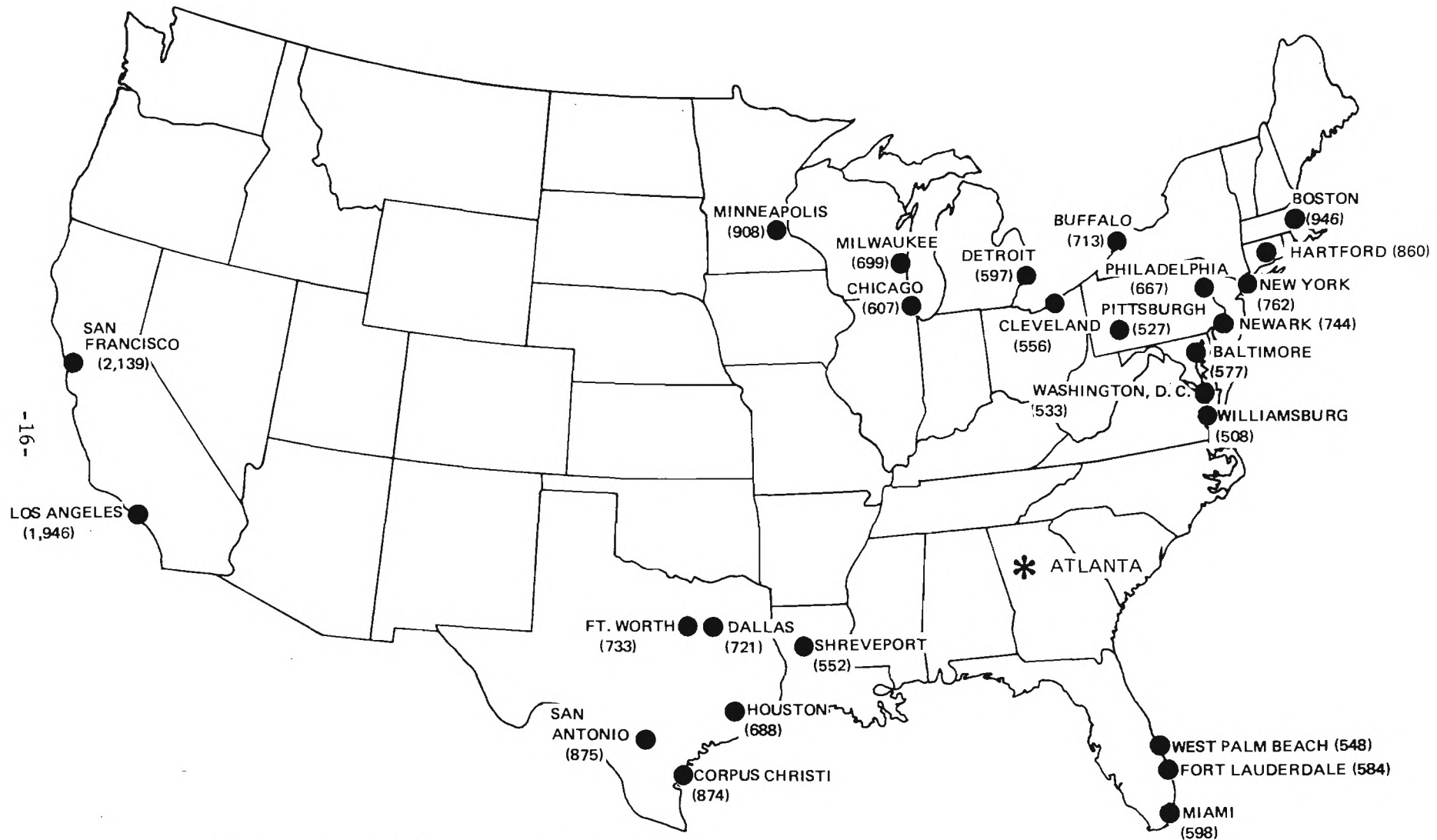


future. Economic utilization of jumbo jets will tend to make them relatively inflexible. They will be operated on long-haul freight routes and will serve the nation's major metropolitan markets. The jumbo jets will demand a large volume of traffic for efficient utilization. The buildup of traffic will require automated air freight terminals designed to facilitate rapid transfer of cargo and specialized ground handling equipment. The high investment costs of such facilities will restrict commercial application by common carrier to the major air traffic hubs such as Atlanta. Map 1 shows the non-stop airline service available from Atlanta to cities at distances of over 500 miles. The congresses of Jamaica and the United States have negotiated and ratified treaties which provide for non-stop service between Atlanta and Jamaica. This action will give Atlanta its first international route in the near future. Similar action is expected on a proposed international route from Atlanta to Mexico in 1971. A previous attempt by Atlanta to secure a route to Italy failed, and therefore, European traffic leaving Atlanta will continue to be routed through one of the eastern international airports, such as J. F. Kennedy in New York.

The presence of jumbo jets in Georgia will make possible, for the first time, air transportation costs for certain commodities equal to, or lower than, common surface modes. Georgia-manufactured products in this density realm (as indicated by references 7 and 8) include men's, boys', and women's clothing, lingerie, blankets, towels, carpeting, certain snack foods, and household furniture. Equal-density commodities moving into Georgia would include a wide spectrum of general department store merchandise in addition to most major home appliances.

Commodities in the "high" density realm will generally have lower transportation costs via surface modes. Georgia-manufactured products in this density realm would include the following: cotton fabrics, yarn, certain food products, lumber, paper products and printed matter, chemicals, and glass, stone, and clay products. Equal-density commodities moving into Georgia could include any of the above items plus industrial machinery and steel products.

NON-STOP AIRLINE SERVICE FROM ATLANTA TO CITIES OVER 500 MILES DISTANT, MARCH 1970



SOURCE: BOOK OF OFFICIAL C. A. B. AIRLINE ROUTE MAPS AND AIRPORT-TO-AIRPORT MILEAGES, FIFTEENTH EDITION, AIRLINE TARIFF PUBLISHERS, INC., WASHINGTON, D. C., MARCH 1970.

SAN JUAN, P. R.
(1,551)

ASSESSMENT OF THE POTENTIAL IMPACT OF JUMBO-JET AIR CARGO
TRANSPORTATION ON GEORGIA INDUSTRIAL DEVELOPMENT

Industrial development has been divided, for the purposes of this analysis, into two growth areas:

Georgia's present spectrum of manufacturing industry.

Sales, service, and distribution functions (representing distant manufacturers) with offices in the Atlanta Metropolitan Area.

Since the cost of jumbo-jet air transportation relative to truck and rail transportation depends largely upon the shipping density of the commodity, the impact assessment has been further divided into the following two categories:

Commodities which can be transported at lowest cost by air.

Commodities which can be transported at lowest cost by truck or rail.

The potential positive and negative effects on Georgia-manufactured products ("low" density) that can be transported at lower cost in jumbo jets are as follows:

Positive Effects

Market Expansion

Air transportation makes "overnight" delivery from Georgia possible throughout the United States and some export markets. It can eliminate the cost of local distribution centers, which may be prohibitively high for initial, small-sales-volume market penetration.

Market Flexibility

The same advantages of air transportation which help keep costs down during market development will make possible rapid reaction to changing markets. Products can be marketed, on a larger geographic scale, where the need and/or the price is greatest.

Subcontracted Manufacturing Potential

Raw materials or subassemblies can be transported to Georgia for local manufacturing processing. If local manufacturing facilities have a lower unit cost than other sections of the country, the difference might be used in part to absorb transportation costs and at the same time develop local skills.

Possible Expansion of Georgia Manufacturing of Air Cargo Transports

The Lockheed 500 was designed and developed by the Lockheed-Georgia Company. If jumbo-jet air cargo grows, the demand for such aircraft could provide a manufacturing opportunity for the Lockheed-Georgia Company as either a prime or subcontractor.

Negative Effect

Market Invasion

The use of air cargo for the development of distant markets can put products in the Georgia market which would be competitive with local industry.

The potential positive and negative effects on sales, service, and distribution functions with offices in the Atlanta Metropolitan Area are as follows:

Positive Effects

Growth of Atlanta as a Transportation Center

The jumbo-jet transports can add a new, expanding dimension to Atlanta as a transportation and distribution center. International air cargo transportation is one of the fastest-growing industries. North Atlantic traffic in 1969 had a 39% increase over 1968 and an average annual increase of more than 30% for the past five years.^{1/}

The cost of jumbo-jet air transportation is more competitive than ever with maritime transportation for "low" density cargo. A prime example of "low" density import cargo is the compact automobile. The jumbo jets have the capability of making possible overnight deliveries of automobiles from Europe to Atlanta.

Expansion of Air Carriers in Georgia

Air carriers serving, or based in, Georgia will have an opportunity for business development. The mixed passenger/cargo configuration of the jumbo jets probably offers the greatest flexibility for development of either the cargo or passenger transportation markets. The possibility of carrying cargo at less than truck or rail rates while transporting passengers for less than current passenger fares demonstrates the potential. Figure 8 shows some possible reduced fare combinations. Boeing has designed a wide range of options of passenger/cargo mix for the 747.

Negative Effects

Potential Reductions in Local Transportation and Warehouse Requirements

Air transportation can provide delivery to the Southeast from any point in the United States that is competitive in elapsed time with surface transportation deliveries out of Atlanta. This capability has the potential of reducing warehousing requirements in Atlanta and local transportation requirements from Atlanta to southeastern cities.

^{1/} Air Transport World, May 1970.

The potential increase in international imports to Atlanta would tend to offset the above reductions. The need for sales and service functions would be expected to increase rather than decrease.

It is considered that the probability is remote for the routine use of air transportation for "high" density Georgia products. Even jumbo-jet transportation for these products costs more (in common carriage) than surface transportation. Although compensating savings in air transportation (packaging, inventory reduction, warehousing) can be found, the development of air cargo as a mode of transportation is of necessity slower under these circumstances than when a clear-cut saving in transportation cost is available. A possible exception to this would be the restricted transportation (on passenger/cargo flights only) of "high" density cargo in a passenger/cargo configuration. Under these shared revenue circumstances, the cost of cargo transportation could be made competitive with truck and rail.

APPENDICES

Appendix A

CAPACITY OF JUMBO JETS

A major factor in assessing the probability of cargo transportation by the jumbo jets in Georgia is the lift capacity of these vehicles. Both the 747 and L 500 in the all-cargo configuration can transport well over 100 tons of cargo on a single flight. The belly compartment of the 747 passenger configuration has the capacity for over 25 tons of cargo. Based on present air cargo operating experience, a great amount of cargo consolidation will be required to economically load the jumbo jets. These aircraft will not only have increased weight capacity, but they will have the ability to transport much larger pieces of equipment than heretofore possible by air. The L 500, for example, can transport as many as 110 compact automobiles. The accompanying table records some of the load capacity statistics of these aircraft.

The success of the jumbo-jet aircraft as a cargo transportation mode will influence the decision whether to build even larger air cargo aircraft. Lockheed has under study an aircraft concept called the "Spanloader" which is a cargo aircraft capable of hauling 1,069,241 pounds. Planned for the 1980's, it promises to provide major advantages for massive air freight operation.

SUMMARY OF JUMBO-JET LOAD CAPACITIES

	L 500 <u>All-Cargo Version</u>	747 <u>All-Cargo Version</u>
Maximum Gross Weight (Aircraft Plus Cargo Plus Fuel)	861,000 lb.	778,000 lb.
Maximum Cargo Weight		
Gross (approx.)	320,000 lb.	275,000 lb.
Gross Less Tare Weight of Container System (approx.)	268,000 lb.	246,000 lb.
Maximum Loadable Volume		
Gross (approx.)	58,000 cu. ft.	34,000 cu. ft.
Containerized (approx.)	29,700 cu. ft.	21,700 cu. ft.
Containerized Transportation Capacity (approx.)	250 million ton-miles/yr. per airplane	250 million ton-miles/yr. per airplane
Main Cargo Compartment		
Maximum Floor Width (approx.)	19.0 ft.	19.5 ft.
Floor Length (approx.)	142.0 ft.	179.0 ft.
Height from Floor to Ceiling (approx.)	13.5 ft.	8.2 ft.
	L 500 <u>Passenger/Cargo Version</u>	747 <u>Passenger/Cargo Version</u>
Typical Passenger Seating Capacity (Upper Deck)	200	375
Typical Cargo Capacity (Lower Compartment)	220,000 lb.	52,000 lb.

Appendix B

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